September 17, 2002

Ms. Tracey Piccone, P.E.
Senior Environmental Engineer
Environmental Engineering Section
CERP/ECP Department
South Florida Water Management District
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South Florida Water Management District
Contract C-E023, Basin-Specific Feasibility Studies
Preliminary Alternative Combinations for the ECP Basins
Draft Evaluation of Alternatives, Part 6
B&McD Project No. 29042

Dear Ms. Piccone:

Burns & McDonnell, in association with Nova Consulting, Inc, is pleased to submit this Part 6 of the Evaluation of Alternatives for the Basin-Specific Feasibility Studies, Everglades Construction Project Basins. This document completes the Draft submittal required under Subtask 4.2 of the Statement of Work (Appendix “C” to Contract C-E023). Also enclosed is a compact disk containing .pdf files of this document. Copies of the various data files and working spreadsheets developed during the course of these studies are also contained on the attached CD.

We look forward to receipt of review comments from the District and other interested parties and stakeholders, and gratefully acknowledge the District’s contributions to the preparation of this draft Part 6. Please feel free to contact me at 816-822-3099 or electronically (gmiller@burnsmcd.com) should you have any questions or desire additional information.

Sincerely,

Galen E. Miller, P.E.
Associate Vice President

Basin-Specific Feasibility Studies

Everglades Protection Area Tributary Basins

Preliminary Alternative Combinations For the ECP Basins

Evaluation of Alternatives Part 6, Integrated Alternative

Submitted to

South Florida Water Management District

September 17, 2002
Contract No. C-E023
Project No. 29042

In Association With

Table of Contents

List of Tables

List of Figures

6. INTEGRATED TREATMENT AREAS

This Part 6 presents the results of an evaluation of a more global alternative in which STA-2, STA-3/4, STA-5 and STA-6, as well as the EAA Reservoirs are treated as an integrated whole. The purpose in development of this Integrated Alternative is to assess the extent to which adjustment of the EAA Storage Reservoirs Project as modeled in the SFWMM 2050wPROJ simulation used for the Basin-Specific Feasibility Studies might effectively contribute to an ability to meet the long-term water quality improvement goals of the Everglades Forever Act, while not sacrificing the hydrologic function of the EAA Reservoirs.

> The Integrated Alternative presented in this Part 6 cannot be considered as an optimized solution. The interrelationships of the various stormwater treatment areas and the potential EAA Storage Reservoirs are highly complex. A wide variety of alternatives could, and should, be postulated and considered in detail. Time and budget restraints inherent in the scope of Contract C-E023 permitted the development of but one of the many possible adjustments which could be made to the 2050wPROJ simulation in the interest of water quality improvement, while maintaining the hydrologic function of the Reservoir(s).

It is anticipated that the Project Development Team (PDT) for the EAA Storage Reservoirs Project, Phase 1 will consider this and other possible adjustments as it develops and evaluates alternatives for that critical CERP component. Based on the results of the analyses presented in this Part 6, it is recommended that the PDT consider the following basic suggestions for enhanced performance of the project in contributing to water quality improvement goals for discharges to the Everglades Protection Area:

- Maximize the proportion of time that storage elevations in the reservoir(s) are above ground (e.g., minimize the frequency and duration of dryout).
- Recognize that water quality improvement performance can be expected to increase with increased depth, at least within the range of possible depths of the EAA Storage Reservoirs(s).
- Note that the total phosphorus loads introduced to the downstream stormwater treatment areas are reduced as the proportion of the total inflow which first pass through the reservoir(s) is increased.

- Understand that, as the surface area of the reservoir increases, not only do evaporation losses increase, but also the atmospheric input of phosphorus and other pollutants to the reservoir and downstream system increases.

Incorporation of the above suggestions into the PDT's alternatives can be expected to favor the development of deeper reservoirs with less surface area, to which the maximum proportion of total basin inflows are directed, and in which strict partitioning of inflows by source and destination is reduced.

The analyses conducted for the single iteration of the Integrated Alternative presented herein employ certain strategies for incorporation of the above suggestions. Those strategies include:

- In lieu of spatial partitioning of storage volumes by source and demand, consider the definition of a minimum storage volume or elevation below which only defined irrigation and environmental water supply releases are made. That elevation or volume can be established to satisfy those demands either for the full period of simulation (as was done herein), or on the basis of a defined drought recurrence interval. Incorporation of this strategy can be expected to lead to a reduced total length of impoundment levees, as well as a reduced number and total installed hydraulic capacity of pumping stations and other water control structures.
- Maximize the use of the water control infrastructure now existing or under construction for the introduction of basin inflows to the reservoir(s). As an example, consider the use of Pumping Stations G-370 and G-372 as inflow pump stations to the reservoir(s), with all STA-3/4 inflows first passing through the reservoir. As compared to the 2050wPROJ simulation, that approach can be expected to minimize the pollutant loads discharged to STA-3/4, while at the same time reducing the extent to which potentially duplicative hydraulic capacity might be installed.
- Direct discharges from the reservoirs to the various stormwater treatment areas in proportion to their capacity for further improving the quality of those discharges (e.g., attempt to "balance" reservoir discharges with downstream treatment capacity).

- Consider expanding the number of sources from which runoff and other discharges are introduced to the reservoir(s). Examples might include the C-139 Basin and the C-139 Annex.

6.1. Basic Information

Parts 4 and 5, respectively, of this document present information based on a SFWMM regional simulation (2050wPROJ) which was performed specifically for the Basin-specific Feasibility Studies. The 2050wPROJ simulation, which included both Phase 1 and Phase 2 of the EAA Storage Reservoirs Project, represents one possible scenario of the combined EAA reservoirs and STAs. It should be noted that the 2050wPROJ simulation included a total of approximately 360,000 acre-feet of storage in the Phase 1 and Phase 2 reservoirs, versus the 240,000 acre-feet of storage currently contemplated in the Phase 1 reservoirs. The 2050wPROJ simulation included the following approximate surface areas of the Phase 1 and Phase 2 reservoir compartments:

- Compartment A1: 20,000 acres
- Compartment A2: 21,500 acres
- Compartment B: 9,500 acres
- Compartment C: 9,000 acres

The total surface area reflected in the 2050wPROJ simulation was approximately 60,000 acres to maintain consistency with the Alternative D13R simulation performed in support of the Restudy Recommended Plan.

Lands acquired by the District and the federal government as a result of the Talisman Land Exchange are available for use in implementation of the EAA Storage Reservoirs Project. The location and areal extent of those lands has been taken from Figure 2 of the January 2002 *EAA Storage Reservoirs Phase 1 Project, Project Management Plan*, which may be found on the CERP website, www.evergladesplan.org. As presented in that reference, the total land areas available as a result of the Talisman Land Exchange are as follows:

- Component A: 31,430 acres
- Component B: 9,302 acres
- Component C: 8,884 acres

The total lands available, as shown on Figure 2 of the PMP, aggregate to 49,616 acres. The EAA Storage Reservoirs Phase 1 Project Delivery Team will evaluate alternatives during the Project Implementation Report (PIR) phase. Depending on the results of this evaluation, the Phase 1 project may or may not incorporate the entire 49,616 acres.

For this Integrated Alternative, it was considered desirable to adjust the 49,616 available acres to reflect the probable loss of effective storage area to perimeter works such as levees and exterior borrow/seepage collection canals. A summary of the adjustments made for this analysis is presented in Table 6.1.

Table 6.1 Effective Surface Areas of EAA Reservoir Components on the Talisman Land

Compart.	Gross Area (ac)	Perimeter	Length (miles	Remarks	Edge Loss (ft)	Edge Loss (ac)	Net Area (ac)
A	31,430	West	6.0	External Borrow	360	262	
		North	11.7	External Borrow	360	511	
		East	8.0	Along NNR Canal; combine interior borrow and berm reconstruction	100	97	
		South	16.0	Along STA-3/4 Supply & Inflow Canal; combine interior borrow and berm reconstruction	100	194	30,367
B	9,302	West	8.7	Along NNR Canal; combine interior borrow and berm reconstruction	100	105	
		North	4.7	External Borrow	360	205	
		East	2.7	External Borrow	360	118	
		East	6.0	Adjacent to STA-2; interior borrow, extend exist levee	0	0	
		Southeast	1.7	Along L-6; combine interior borrow and berm reconstruction	100	21	8,853
C	8,884	West	6.7	Along L-3; combine interior borrow and berm reconstruction	100	81	
		North	4.0	Adjacent to STA-5; interior borrow, extend exist levee	0	0	
		East	4.0	Adjacent to Rotenberger Tract; interior borrow	200	97	
		South	3.2	Adjacent to STA-6; interior borrow, extend exist levee	0	0	8,706

For this Integrated Alternative, the net effective surface area of the three components is taken as 47,930 acres, comprised of 30,370 acres in Component A; 8,850 acres in Component B; and 8,710 acres in Component C.

A summary of the total average annual inflows to this Integrated Alternative is presented in Table 6.2. The information presented therein simply totals the 2050wPROJ simulated "future" (e.g., with CERP) inflows for the individual components of the overall Phase 1 and Phase 2 EAA Storage Reservoirs project developed and discussed in Parts 3 through 5, respectively.

Table 6.2 Aggregate Average Annual Inflows to Integrated Alternative

Source	Average Annual Inflow by Hydrographic Unit, Future (With CERP)										
	Western Canals		Miami Canal		NNR Canal		Hillsboro Canal		Total		Mean
	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)	TP Conc (ppb)
Lake Okeechobee											
Regulatory Releases	0	0	175,012	14,381	215,684	18,951	0	0	390,696	33,332	69
BMP Makeup Water	0	0	46,814	3,847	30,502	2,680	7,235	661	84,551	7,188	69
STA Irrigation Water	0	0	680	56	0	0	122	11	802	67	68
S-6/S-2 Basin Runoff	0	0	0	0	0	0	186,623	22,284	186,623	22,284	97
S-7/S-2 Basin Runoff	0	0	0	0	194,025	22,800	0	0	194,025	22,800	95
S-8/S-3 Basin Runoff	0	0	178,671	21,909	0	0	0	0	178,671	21,909	99
S-236 Basin	0	0	11,075	1,858	0	0	0	0	11,075	1,858	136
SSDD Basin	0	0	4,851	598	0	0	0	0	4,851	598	100
Eastern 298	0	0	0	0	0	0	14,409	3,661	14,409	3,661	206
C-139 Basin	149,704	33,070	11,203	1,939	0	0	0	0	160,907	35,009	176
C-139 Annex	11,944	1,180	0	0	0	0	0	0	11,944	1,180	80
All Sources	**161,648**	**34,250**	**428,306**	**44,588**	**440,211**	**44,431**	**208,389**	**26,617**	**1,238,554**	**149,886**	98
FW Mean Conc. (ppb)		**172**		**84**		**82**		**104**		**98**	

On average, approximately 13% of the inflow volume and 23% of the TP load is delivered in the Western Canals (L-2, Deer Fence, S&M, and L-3, considered to include the C-139 Annex). The Miami Canal is expected to deliver 35% of the average inflow volume and 30% of the TP load to the integrated project. The North New River Canal is expected to deliver 36% of the inflow volume and 30% of the TP load, with the remainder (16% of the volume and 17% of the TP load) arriving in the Hillsboro Canal.

A basic premise of this Integrated Alternative is that the hydrologic function of the EAA Storage Reservoir Project as simulated in 2050wPROJ for the Basin Specific Feasibility Studies not be compromised in the interest of water quality improvement. For this Integrated Alternative, the performance measure selected to address that premise is the extent to which water supply demands on the various reservoir components can be met. Table 6.3 presents a summary of the average annual environmental and Everglades Agricultural Area (EAA) water supply demands reflected in the 2050wPROJ simulation for the future (with CERP) condition. Those simulated demands are treated in this Integrated Alternative as fixed demands that must be met (on a daily basis over the 31-year simulation period) in the operation of the Integrated Alternative.

Table 6.3 Fixed Water Supply Demands

Description	Ave. Annual Demand in Acre-Feet				
	Comp. A1	Comp. A2	Comp. B	Comp. C	Total
Environmental Water Supply					
Surface	0	77,965	140,420	42,243	260,628
Subsurface	0	4,226	5,516	3,086	12,828
EAA Water Supply					
Miami Canal Basin	68,632	2,179	0	0	70,811
North New River Canal Basin	77,883	2,800	0	0	80,683
Total "Fixed" Demands	**146,515**	**87,170**	**145,936**	**45,329**	**424,950**

6.1.1. Baseline Discharges

Baseline discharges against which the performance of the Integrated Alternative will be measured consist of a summation of the baseline discharges from STA-2, STA-3/4, and STA-5 and 6 as defined in Parts 3, 4, and 5, respectively. The baseline discharges are summarized in Table 6.4.

Table 6.4 Baseline Discharges for Integrated Alternative

STA Identification	Total Discharge (2007-2056)		
	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
STA-2 (refer to Table 3.9)	10,105,800	386,911	31
STA-3/4 (refer to Table 4.13)	29,689,800	1,198,224	33
STA-5 (refer to Table 5.19)	6,920,800	388,668	46
STA-6 (refer to Table 5.20)	2,701,600	100,944	30
Total Discharge for Period	**49,418,000**	**2,074,747**	
Ave. Annual Discharge for Period	**988,360**	**41,494.9**	**34**

6.2. General Configuration

A schematic of the general configuration of the Integrated Alternative is presented in Figure 6.1.

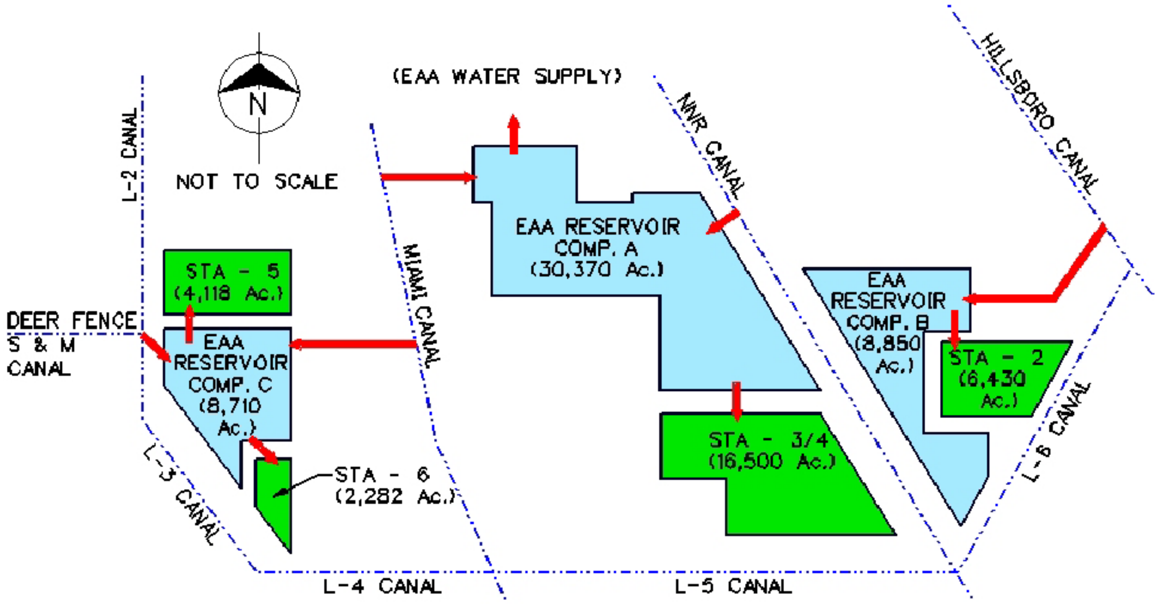

Figure 6.1 General Schematic, Integrated Alternative

As indicated in Figure 6.1, the total estimated net area of the available land of the EAA Storage Reservoirs is 47,930 acres. Note that the Phase 1 project may or may not use all 47,930 acres. The total effective treatment area of the four STAs to which those reservoirs would discharge is 27,091 acres. The flows presented in Table 6.2, 6.3, and 6.4 are the result of a full CERP simulation, i.e., all CERP components are in place including both Phase 1 and Phase 2 of the EAA Storage Reservoirs Project, and the ASR projects.

6.3. Reservoir Component C, STA-5 and STA-6

For this Integrated Alternative, it is assumed that all runoff from the C-139 Basin and the C-139 Annex are routed to Component C of the EAA Reservoirs Project in addition to the presently simulated inflows (regulatory releases) from Lake Okeechobee. Outflows from the reservoir would then be distributed to STA-5 and STA-6, in proportion to their estimated treatment capacity. STA-5 and STA-6 would be enhanced similar to Alternative 4 as it is described in Part 5. In addition, the proposed STA-6 control structure flexibility (as described in Part 5 Alt 4) is used to shift 6% of total inflows away from Cell 3 (mostly to Cells 2/4) in this Integrated Alternative due to resultant phosphorus concentrations slightly above geometric mean target (10 ppb). The average annual inflow volume over the 31-year period of the simulation is estimated to be 211,681 acre-feet, which includes an average annual inflow of 50,033 acre-feet of regulatory releases from Lake Okeechobee. The average annual inflow TP load to the reservoir is 38,361 kilograms, which includes an average annual inflow load of 4,111 kg in regulatory releases from Lake Okeechobee. The flow-weighted mean TP concentration in inflows to Component C is 147 ppb.

The physical configuration of the reservoir is modified from that discussed in Part 5, Alternative 4, to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 8,710 acres, and the average land surface elevation is assumed equal to that in the SFWMM 2050wPROJ simulation (13.86 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-6. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation.

Total daily discharges from the reservoir were assigned at the <u>greater</u> of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply.
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=0.274*(D-1.5)^5, \text{ where}$$

Q= daily discharge volume in acre-feet
D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 15.36 ft. NGVD (1.5 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day's stage was equal to or less than 15.36 ft. NGVD, <u>unless</u> the SFWMM

2050wPROJ simulation indicated the need for environmental water supply. The following stage and depth data resulted from the analysis:

> Maximum stage = 22.95 ft. NGVD (mean depth of 9.09 ft., or 2.77m).
> Average stage = 19.13 ft. NGVD (mean depth of 5.27 ft., or 1.61 m)
> Minimum stage = 13.91 ft. NGVD (mean depth of 0.05 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-5 and STA-6 through Compartment C on total phosphorus loads and concentrations entering the two treatment areas. Application of the above operating "rule" to Compartment C did permit all "fixed" daily water supply demands to be met.

6.3.1. TP Reduction in Component C of EAA Storage Reservoir

For this Integrated Alternative, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component C in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-5 and STA-6. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A summary of the long-term estimates of TP reduction in Component C of the EAA Storage Reservoir is presented in Table 6.5.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.5 Estimated TP Reduction in Component C of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)				**1.604**
Approx. Basin Area (acres)					**8,710**
Approx. Basin Area (sq.m.)					**35,248,238**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)				
Input Parameters			**Estimated TP Removal**		
Average Inlet Concentration	mg/l	0.1467	q	7.312	
Average Annual Inflow Volume	ac-ft	211,681	K	0.060	
Average Annual Inflow Volume	cu.m.	261,105,717	P	153	ppb
Average Annual Rainfall	m	1.321	N	2.028	
Average Annual Evapotranspiration	m	1.366		3.019	
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.502	
Infiltration from Groundwater	m/yr	0.000	Pout	76	ppb
Water Balance Adjustment & Exfiltration	m/yr	0.1770	Pout	0.0763	mg/l
Change in Storage	m./yr.	0.051	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987	
Ave. TP Conc. In Seepage Inflows	mg/l	0.000			
Wet Period Fraction		1.000			
SUMMARY OF RESULTS					
Reservoir Area	acres	8,710			
Ave. Annual Outflow Volume	cu.m.	251,493,523			
Ave. Annual Outflow Volume	ac-ft	203,888		Surface Discharges Only	
Mean TP Conc. In Outflows	mg/l	0.0763			

Discharges from Component C were considered as distributed to STA-5 and STA-6 in proportion to the available effective treatment area (4,118 acres in STA-5, 2,282 acres in STA-6). As a result, 64.3% of the daily discharges from Component C were assigned to STA-5, with the remainder assigned to STA-6.

6.3.2. TP Reduction in STA-5 and STA-6

For the Integrated Alternative, STA-5 and STA-6 were considered to be optimized or enhanced as described in Part 5 for Alternative 4 at each treatment area. Summaries of the estimated treatment performance of STA-5 and STA-6 for this alternative are presented in Tables 6.6 and 6.7, respectively, which consist of screen information taken directly from the DMSTA analyses.

6.4. Reservoir Component B, STA-2

For this Integrated Alternative, it is assumed that all STA-2 inflows are first routed to Component B of the EAA Reservoirs Project, and that there are no other inflows to that reservoir component. Outflows from the reservoir would then be delivered to STA-2, which would be optimized similar to that described for Alternative 2 in Part 3. The average annual inflow volume over the 31-year period of the simulation is estimated to be 208,267 acre-feet. The average annual inflow TP load to the reservoir is 23,060 kilograms. The flow-weighted mean TP concentration in inflows to Component B is 90 ppb.

The physical configuration of the reservoir is modified from that discussed in Part 4, Alternative 1, to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 8,850 acres, and the average land surface elevation is assumed equal to that in the SFWMM 2050wPROJ simulation (10.60 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-2. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation.

Table 6.6 Results of DMSTA Analysis, Integrated Alternative, STA-5

Input Variable	Units	Value
Design Case Name	-	ALTInt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: Cells 1A & 2A--Emergent & Cells 1B & 2B--SAV_C4
Integrated STAs
64.3% Comp C Flows to STA-5

Filename: 5ALTInt1_Data.xls

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	-0.1%
Flow-Wtd Conc - With Bypass	ppb	12.7
Flow-Wtd Conc - Without Bypass	ppb	12.7
Geometric Mean Conc	ppb	7.4
95th Percentile Conc	ppb	16.4
Freq Cell Outflow > 10 ppb	%	28%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B		
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4		
Inflow Fraction	-	0.5	0	0.5	0		
Downstream Cell Number	-	2	0	4	0		
Surface Area	km2	3.379	4.937	3.379	4.937		
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56		
Number of Tanks in Series	-	3	3	3	3		
Outflow Control Depth	cm	40	60	40	60		
Outflow Coefficient - Exponent	-	2.8	2.15	2.91	1.78		
Outflow Coefficient - Intercept	-	1.57	2.02	1.51	2.1		
Bypass Depth	cm	0	0	0	0		
Maximum Inflow	hm3/day	0	0	0	0		
Maximum Outflow	hm3/day	0	0	0	0		
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0		
Inflow Seepage Control Elev	cm	0	0	0	0		
Inflow Seepage Conc	ppb	20	20	20	20		
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0014	0.0015	0.0033		
Outflow Seepage Control Elev	cm	-46	-38	-46	-38		
Max Outflow Seepage Conc	ppb	20	20	20	20		
Seepage Recycle Fraction	-	0.5	0.5	0.5	0.5		
Seepage Discharge Fraction	-	0	0	0	0		
Initial Water Column Conc	ppb	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	500	500	500	500		
Initial Water Column Depth	cm	50	50	50	50		
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*		
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*		
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*		
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*		
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*		
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*		
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*		
Zx - Periphyton	cm	*0*	*0*	*0*	*0*		
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*		
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*		

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	6.90	13.39	20.45	27.84			27.84
Run Date	-	06/17/02	06/17/02	06/17/02	06/17/02			06/17/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65			01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95			12/31/95
Output Duration	days	11322	11322	11322	11322			11322
Cell Label		1A	1B	2A	2B			Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow			-
Surface Area	km2	3.379	4.937	3.379	4.937			16.6
Mean Water Load	cm/d	6.6	4.4	6.6	4.4			2.7
Max Water Load	cm/d	74.8	50.9	74.8	50.9			30.4
Inflow Volume	hm3/yr	80.9	79.6	80.9	79.6			161.8
Inflow Load	kg/yr	6274.5	4200.6	6274.5	4166.6			12548.9
Inflow Conc	ppb	77.5	52.8	77.5	52.4			77.5
Treated Outflow Volume	hm3/yr	79.6	77.6	79.6	76.0			153.6
Treated Outflow Load	kg/yr	4200.6	985.3	4166.6	969.9			1955.3
Treated FWM Outflow Conc	ppb	52.8	12.7	52.4	12.8			12.7
Total FWM Outflow Conc	ppb	52.8	12.7	52.4	12.8			12.7
Surface Outflow Load Reduc	%	33.1%	76.5%	33.6%	76.7%			84.4%
Outflow Geometric Mean - Daily	ppb	52.0	7.6	51.8	7.8			7.6
Outflow Geo Mean - Composites	ppb	51.6	7.4	51.4	7.6			7.4
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	0%			28%

Table 6.7 Results of DMSTA Analysis, Integrated Alternative, STA-6

Input Variable	Units	Value	Case Description:	Filename:	6ALTInt1_650530_Data.xls
Design Case Name	-	ALTInt1	Cells 2,3 & 5a--Emergent and Cells 4 & 5b--SAV_C4		
Starting Date for Simulation	-	01/01/65	Integrated STAs		
Ending Date for Simulation	-	12/31/95	35.7% Comp C Flows to STA-6		
Starting Date for Output	-	01/01/65	65%/5%/30% internal flow split		
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	13.4
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	13.4
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	7.7
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	17.1
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	24%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	2	4	3	5a	5b	
Vegetation Type	------->	EMERG	SAV_C4	EMERG	EMERG	SAV_C4	
Inflow Fraction	-	0.65	0	0.05	0.3	0	
Downstream Cell Number	-	2	0	0	5	0	
Surface Area	km2	2.242	3.363	0.991	1.056	1.582	
Mean Width of Flow Path	km	2.34	2.32	0.61	1.12	1.48	
Number of Tanks in Series	-	3	3	3	3	3	
Outflow Control Depth	cm	40	60	40	40	60	
Outflow Coefficient - Exponent	-	1.67	1.67	3.08	3.56	5.07	
Outflow Coefficient - Intercept	-	0.18	0.2	0.63	0.29	0.24	
Bypass Depth	cm	0	0	0	0	0	
Maximum Inflow	hm3/day	0	0	0	0	0	
Maximum Outflow	hm3/day	0	0	0	0	0	
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	
Inflow Seepage Control Elev	cm	0	0	0	0	0	
Inflow Seepage Conc	ppb	20	20	20	20	20	
Outflow Seepage Rate	(cm/d) / cm	0.0059	0.0017	0	0	0	
Outflow Seepage Control Elev	cm	-46	-46	0	0	0	
Max Outflow Seepage Conc	ppb	20	20	20	20	20	
Seepage Recycle Fraction	-	0.5	0.5	0	0	0	
Seepage Discharge Fraction	-	0	0	0	0	0	
Initial Water Column Conc	ppb	30	30	30	30	30	
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	
Initial Water Column Depth	cm	50	50	50	50	50	
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*15.66*	*80.10*	
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	7.42	14.03	20.42	27.42	34.52		34.52
Run Date	-	06/19/02	06/19/02	06/19/02	06/19/02	06/19/02		06/19/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65		01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95		12/31/95
Output Duration	days	11322	11322	11322	11322	11322		11322
Cell Label		2	4	3	5a	5b		Total Outflow
Downstream Cell Label		4	Outflow	Outflow	5b	Outflow		-
Surface Area	km2	2.242	3.363	0.991	1.056	1.582		9.2
Mean Water Load	cm/d	7.1	4.5	1.2	7.0	4.7		2.7
Max Water Load	cm/d	81.4	52.3	14.2	79.8	53.2		30.4
Inflow Volume	hm3/yr	58.4	55.9	4.5	27.0	26.9		89.9
Inflow Load	kg/yr	4528.7	2861.7	348.4	2090.2	1374.8		6967.3
Inflow Conc	ppb	77.5	51.2	77.5	77.5	51.1		77.5
Treated Outflow Volume	hm3/yr	55.9	54.6	4.4	26.9	26.8		85.9
Treated Outflow Load	kg/yr	2861.7	697.3	110.2	1374.8	342.3		1149.8
Treated FWM Outflow Conc	ppb	51.2	12.8	24.8	51.1	12.8		13.4
Total FWM Outflow Conc	ppb	51.2	12.8	24.8	51.1	12.8		13.4
Surface Outflow Load Reduc	%	36.8%	75.6%	68.4%	34.2%	75.1%		83.5%
Outflow Geometric Mean - Daily	ppb	50.6	7.9	21.4	48.8	6.8		8.9
Outflow Geo Mean - Composites	ppb	50.4	7.6	21.6	48.9	7.1		7.7
Frequency Outflow Conc > 10 ppb	%	100%	0%	100%	100%	0%		30%

Total daily discharges from the reservoir were assigned at the greater of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply. For this analysis, all such releases are assigned to Component A, tributary to STA-3/4 (other than those previously assigned to Component C).
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=19.50*(D-1.0)^{3.5}\text{, where}$$

Q= daily discharge volume in acre-feet
D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 11.60 ft. NGVD (1.0 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day's stage was equal to or less than 11.60 ft. NGVD. The following stage and depth data resulted from the analysis:

Maximum stage = 16.89 ft. NGVD (mean depth of 6.29 ft., or 1.92m).
Average stage = 13.80 ft. NGVD (mean depth of 3.20 ft., or 0.98 m)
Minimum stage = 11.40 ft. NGVD (mean depth of 0.80 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-2 through Compartment B on total phosphorus loads and concentrations entering the treatment area.

6.4.1. TP Reduction in Component B of EAA Storage Reservoir

For this analysis, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component B in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-2. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. Summaries of the long-term estimates of TP reduction in Component B of the EAA Storage Reservoir are presented in Table 6.8.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.8 Estimated TP Reduction in Component B of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)					**0.975**
Approx. Basin Area (acres)						**8,850**
Approx. Basin Area (sq.m.)						**35,814,800**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.1036	q	7.444		
Average Annual Inflow Volume	ac-ft	208,268	K	0.061		
Average Annual Inflow Volume	cu.m.	256,894,795	P	104	ppb	
Average Annual Rainfall	m	1.303	N	0.833		
Average Annual Evapotranspiration	m	1.009		2.081		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.0253	R	0.351		
Infiltration from Groundwater	m/yr	0.000	Pout	68	ppb	
Water Balance Adjustment & Exfiltration	m/yr	0.536	Pout	0.0677	mg/l	
Change in Storage	m./yr.	0.0226	REF:	*Phosphorus Removal by Urban Runoff*		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000		*Detention Basins;* Lake and Reservoir		
Wet Period Fraction		1.000		Management, Volume 3; North American		
				Lake Management Society; 1987		
SUMMARY OF RESULTS						
Reservoir Area	acres	8,850				
Ave. Annual Outflow Volume	cu.m.	247,403,873				
Ave. Annual Outflow Volume	ac-ft	200,572		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0677				

6.4.2. TP Reduction in STA-2

For the Integrated Alternative, STA-2 was considered to be optimized or enhanced as described in Part 3 for Alternative 2. A summary of the estimated treatment performance of STA-2 for this alternative is presented in Table 6.9, which consists of screen information taken directly from the DMSTA analysis.

Table 6.9 Results of DMSTA Analysis, Integrated Alternative, STA-2

Input Variable	Units	Value	Case Description:	Filename:	2ALTInt1_Data.xls
Design Case Name	-	ALTInt1	Cells 1A & 2A--Emergent & Cell 1B, 2B, 3A & 3B--SAV_C4		
Starting Date for Simulation	-	01/01/65	Integrated STAs		40/60 Split
Ending Date for Simulation	-	12/31/95	STA-2 Flows only to/from Comp B		
Starting Date for Output	-	01/01/65			
Steps Per Day	-	3	**Output Variable**	**Units**	**Value**
Number of Iterations	-	2	Water Balance Error	%	0.0%
Output Averaging Interval	days	7	Mass Balance Error	%	-0.1%
Reservoir H2O Residence Time	days	0	Flow-Wtd Conc - With Bypass	ppb	11.5
Max Inflow / Mean Inflow	-	0	Flow-Wtd Conc - Without Bypass	ppb	11.5
Max Reservoir Storage	hm3	0	Geometric Mean Conc	ppb	5.7
Reservoir P Decay Rate	1/yr/ppb	0	95th Percentile Conc	ppb	15.2
Rainfall P Conc	ppb	10	Freq Cell Outflow > 10 ppb	%	15%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	SAV_C4	SAV_C4
Inflow Fraction	-	0.28	0	0.36	0	0.36	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514
Mean Width of Flow Path	km	1.58	1.58	3.10	1.65	2.00	2.00
Number of Tanks in Series	-	3	3	3	3	3	3
Outflow Control Depth	cm	40	60	40	60	60	60
Outflow Coefficient - Exponent	-	2.48	2.53	2.92	1.99	2.93	3.05
Outflow Coefficient - Intercept	-	0.48	0.62	0.39	1.28	0.48	0.64
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0.008	0.008	0	0	0	0
Inflow Seepage Control Elev	cm	76	76	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.009	0	0.015	0	0.015	0.006
Outflow Seepage Control Elev	cm	-61	0	-61	0	-30	-30
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.78	0	0.78	0	0.78	0.79
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*80.10*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	1.06	2.03	3.00	3.97	4.90	5.90	5.90
Run Date	-	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02	07/14/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	2.912	4.368	3.676	5.514	3.676	5.514	25.7
Mean Water Load	cm/d	6.5	4.3	6.6	4.2	6.6	4.2	2.6
Max Water Load	cm/d	55.2	36.3	56.2	37.2	56.2	37.1	22.4
Inflow Volume	hm3/yr	69.3	68.5	89.1	83.7	89.1	84.4	247.6
Inflow Load	kg/yr	4746.0	2959.7	6102.0	3570.4	6102.0	1543.0	16950.0
Inflow Conc	ppb	68.5	43.2	68.5	42.6	68.5	18.3	68.5
Treated Outflow Volume	hm3/yr	68.5	69.6	83.7	82.9	84.4	81.3	233.8
Treated Outflow Load	kg/yr	2959.7	806.0	3570.4	1033.8	1543.0	844.8	2684.6
Treated FWM Outflow Conc	ppb	43.2	11.6	42.6	12.5	18.3	10.4	11.5
Total FWM Outflow Conc	ppb	43.2	11.6	42.6	12.5	18.3	10.4	11.5
Surface Outflow Load Reduc	%	37.6%	72.8%	41.5%	71.0%	74.7%	45.2%	84.2%
Outflow Geometric Mean - Daily	ppb	42.3	6.2	41.1	6.4	11.2	5.2	5.7
Outflow Geo Mean - Composites	ppb	42.4	6.1	41.3	6.3	11.2	5.1	5.7
Frequency Outflow Conc > 10 ppb	%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	16%

6.5. Reservoir Component A, STA-3/4

All inflows to the Integrated Alternative not assigned to Components B or C of the EAA Storage Reservoirs project are assigned to Component A. Those inflows include:

- All regulatory releases from Lake Okeechobee, other than the 50,033 acre-feet per year average annual volume assigned to Component C.
- All runoff from the Miami Canal and North New River basins.
- All other inflows directed to the Miami and North New River canals.

The average annual inflows to Compartment A are then estimated to be:

- An average annual inflow of 818,484 acre-feet.
- An average annual inflow TP load of 84,908 kilograms.

The flow-weighted mean TP concentration in inflows to Component A are estimated to be 84 ppb. All discharges from Component A (other than irrigation supply to the S-7 and S-8 basins) would be directed to STA-3/4, which would be optimized similar to that described for Alternative 2 in Part 4.

The physical configuration of the reservoir is modified from that discussed in Part 4 to reflect the estimated net area of the reservoir available within the footprint of the lands obtained under the Talisman Land Exchange. The area of the reservoir is set at 30,370 acres, and the average land surface elevation is assumed equal to the average of Compartments A1 and A2 in the SFWMM 2050wPROJ simulation (11.74 ft. NGVD). Daily rainfall and evapotranspiration estimates were taken from the data set for STA-3/4. Seepage losses from the reservoir (unrecovered) were assigned at 0.1 m/yr/m depth, consistent with the SFWMM 2050wPROJ simulation. Total daily discharges from the reservoir were assigned at the greater of the following:

- Reservoir releases established at the daily values taken from the SFWMM 2050wPROJ simulation for environmental water supply, and for Miami Canal Basin and North New River Canal Basin irrigation. In this instance, those releases include all of the following:
    - Miami Canal and North New River Canal Basin irrigation water supplied from Compartment A1, as represented in the SFWMM 2050wPROJ simulation.
    - Miami Canal and North New River Canal Basin irrigation water supplied from Compartment A2, as represented in the SFWMM 2050wPROJ simulation.
    - Environmental water supply to STA-3/4 from Compartment A2, including both surface and subsurface flows, as represented in the SFWMM 2050wPROJ simulation.
    - Environmental water supply to STA-3/4 from Compartment A2, including both surface and subsurface flows, as represented in the SFWMM 2050wPROJ simulation.
- A stage-driven discharge rating, in which the desired total volume of release on any given day is established on the basis of the previous day stage in the reservoir. The discharge rating employed in this analysis is in the form:

$$Q=0.33*(D-4.0)^6, \text{ (max. = 12,774), where}$$

Q= daily discharge volume in acre-feet
D= mean depth in the reservoir (e.g., stage minus mean ground surface elevation), in feet, on the previous day.

The analysis was initiated with an assigned stage of 15.74 ft. NGVD (4.0 ft. above the mean ground surface elevation). As indicated above, no discharge was assumed from the reservoir if the previous day’s stage was equal to or less than 15.74 ft. NGVD, <u>unless</u> the SFWMM 2050wPROJ simulation indicated the need for either environmental water supply or irrigation water supply. The maximum rate of discharge from the reservoir (12,774 acre-feet per day) was established equal to the maximum design rate of inflow to STA-3/4 reflected in its current design. In essence, for all reservoir stages above elevation 21.5 ft. NGVD, the daily discharge was set at 12,774 acre-feet. The following stage and depth data resulted from the analysis:

Maximum stage = 22.65 ft. NGVD (mean depth of 10.91 ft., or 3.33m).

Average stage = 18.33 ft. NGVD (mean depth of 6.59 ft., or 2.01 m)

Minimum stage = 11.75 ft. NGVD (mean depth of 0.01 ft.)

The wet period fraction (e.g., proportion of time for which the water surface is above the mean ground surface elevation) for this analysis is 1.00.

It is noted that the above assumed operating "rule" for the reservoir is simplistic in nature; any number of operating rules could be postulated and tested. The purpose of this analysis was primarily to assess the impact of routing all 2050wPROJ simulated inflows to STA-3/4 through Compartment A on total phosphorus loads and concentrations entering the treatment area. Application of the above operating "rule" to Compartment A did permit all "fixed" daily water supply demands to be met.

6.5.1. TP Reduction in Component A of EAA Storage Reservoir

For this analysis, it was necessary to estimate TP reductions in the EAA Storage Reservoir Component A in order to attach daily flow-weighted TP concentrations and loads to discharges from the reservoir to STA-3/4. Those estimates were developed on the assumption that daily uptake rates in the reservoirs are proportional to the volume stored and the square of the concentration in the reservoir (e.g., second-order relationship between concentration and reduction). No calibrated relationship for daily uptake in shallow reservoirs in South Florida is available. For this analysis, the long-term average flow-weighted mean TP concentration in surface outflows from the reservoir was estimated by methods presented in *Phosphorus Removal by Urban Runoff Detention Basins*, W.W. Walker, Ph.D., Lake and Reservoir Management, Volume 3; North American Lake Management Society, 1987.

Daily uptake rates were then adjusted by iterative analysis until the long-term mean flow-weighted TP concentration in discharges from the compartment yielded the same result as the long-term average estimates. A summary of the long-term estimate of TP reduction in Component A of the EAA Storage Reservoir is presented in Table 6.10.

The estimated performance of the EAA Reservoir components in reduction of total phosphorus as discussed herein is preliminary in nature, and must be considered as an approximation only. While considered adequate for feasibility level investigations, these performance estimates may and will be subject to significant adjustment during more detailed design and investigations.

Table 6.10 Estimated TP Reduction in Component A of the EAA Reservoirs

Mean Depth in Reservoir (m)	(For wet period fraction)					**2.01**
Approx. Basin Area (acres)						**30,370**
Approx. Basin Area (sq.m.)						**122,903,442**
ESTIMATED TREATMENT IN RESERVOIR	(Analyze as for reservoir per Walker 1987)					
Input Parameters			**Estimated TP Removal**			
Average Inlet Concentration	mg/l	0.084	q	7.939		
Average Annual Inflow Volume	ac/ft	817,848	K	0.064		
Average Annual Inflow Volume	cu.m.	1,008,806,119	P	91	ppb	
Average Annual Rainfall	m	1.29	N	1.456		
Average Annual Evapotranspiration	m	1.48		2.612		
Average TP Conc. In Rainfall (wet+dry)	mg/l	0.026	R	0.446		
Infiltration from Groundwater	m/yr	0.00	Pout	50	ppb	
Seepage Out	m/yr	0.16	Pout	0.0501	mg/l	
Change in Storage	m./yr.	0.08	REF:	*Phosphorus Removal by Urban Runoff Detention Basins;* Lake and Reservoir Management, Volume 3; North American Lake Management Society; 1987		
Ave. TP Conc. In Seepage Inflows	mg/l	0.000				
Wet Period Fraction		1.000				
SUMMARY OF RESULTS						
Reservoir Area	acres	30,370				
Ave. Annual Outflow Volume	cu.m.	955,928,142				
Ave. Annual Outflow Volume	ac-ft	774,979		Surface Discharges Only		
Mean TP Conc. In Outflows	mg/l	0.0501				

6.5.2. TP Reduction in STA-3/4

For the Integrated Alternative, STA-3/4 was considered to be optimized or enhanced as described in Part 4 for Alternative 2. A summary of the estimated treatment performance of STA-3/4 for this alternative is presented in Table 6.11, which consists of screen information taken directly from the DMSTA analysis.

Table 6.11 Results of DMSTA Analysis, Integrated Alternative, STA-3/4

Input Variable	Units	Value
Design Case Name	-	AltInt1
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	12/31/95
Starting Date for Output	-	01/01/65
Steps Per Day	-	3
Number of Iterations	-	2
Output Averaging Interval	days	7
Reservoir H2O Residence Time	days	0
Max Inflow / Mean Inflow	-	0
Max Reservoir Storage	hm3	0
Reservoir P Decay Rate	1/yr/ppb	0
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description: **Filename:** **34ALTInt1_Data.xls**

Cells 1A, 2A & 3A--Emergent & Cells 1B, 2B & 3B--SAV_C4
Integrated STAs (Compartment A)

Output Variable	Units	Value
Water Balance Error	%	0.0%
Mass Balance Error	%	0.0%
Flow-Wtd Conc - With Bypass	ppb	12.6
Flow-Wtd Conc - Without Bypass	ppb	12.6
Geometric Mean Conc	ppb	8.4
95th Percentile Conc	ppb	16.5
Freq Cell Outflow > 10 ppb	%	26%
Bypass Load	%	0.0%

Cell Number -->		1	2	3	4	5	6
Cell Label	-	1A	1B	2A	2B	3A	3B
Vegetation Type	------->	EMERG	SAV_C4	EMERG	SAV_C4	EMERG	SAV_C4
Inflow Fraction	-	0.48	0	0.28	0	0.24	0
Downstream Cell Number	-	2	0	4	0	6	0
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	4.88
Number of Tanks in Series	-	6	3	6	3	4	4
Outflow Control Depth	cm	60	60	60	60	60	60
Outflow Coefficient - Exponent	-	2.45	2.9	2.6	3	2.1	2.1
Outflow Coefficient - Intercept	-	0.68	0.77	0.85	1.05	0.52	0.52
Bypass Depth	cm	0	0	0	0	0	0
Maximum Inflow	hm3/day	0	0	0	0	0	0
Maximum Outflow	hm3/day	0	0	0	0	0	0
Inflow Seepage Rate	(cm/d) / cm	0	0	0	0	0	0
Inflow Seepage Control Elev	cm	0	0	0	0	0	0
Inflow Seepage Conc	ppb	20	20	20	20	20	20
Outflow Seepage Rate	(cm/d) / cm	0.0058	0.0029	0.0014	0	0.0038	0
Outflow Seepage Control Elev	cm	-56	-56	-67	0	-64	0
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20
Seepage Recycle Fraction	-	0.51	0.52	0.46	0	0.46	0
Seepage Discharge Fraction	-	0	0	0	0	0	0
Initial Water Column Conc	ppb	30	30	30	30	30	30
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500
Initial Water Column Depth	cm	50	50	50	50	50	50
C0 = WC Conc at 0 g/m2 P Storage	ppb	*4*	*4*	*4*	*4*	*4*	*4*
C1 = WC Conc at 1 g/m2 P storage	ppb	*22*	*22*	*22*	*22*	*22*	*22*
K = Net Settling Rate at Steady State	m/yr	*16*	*80*	*15.66*	*80.10*	*15.66*	*80.10*
Zx = Depth Scale Factor	cm	*60*	*60*	*60*	*60*	*60*	*60*
C0 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
C1 - Periphyton	ppb	*0*	*0*	*0*	*0*	*0*	*0*
K - Periphyton	1/yr	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Zx - Periphyton	cm	*0*	*0*	*0*	*0*	*0*	*0*
Sm = Transition Storage Midpoint	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*
Sb = Transition Storage Bandwidth	mg/m2	*0*	*0*	*0*	*0*	*0*	*0*

Output Variables	Units	1	2	3	4	5	6	Overall
Execution Time	seconds/yr	12.07	18.42	33.58	40.52	49.07	57.65	57.65
Run Date	-	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02	06/28/02
Starting Date for Simulation	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Starting Date for Output	-	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65	01/01/65
Ending Date	-	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95	12/31/95
Output Duration	days	11322	11322	11322	11322	11322	11322	11322
Cell Label		1A	1B	2A	2B	3A	3B	Total Outflow
Downstream Cell Label		1B	Outflow	2B	Outflow	3B	Outflow	-
Surface Area	km2	12.298	14.115	10.287	11.712	8.713	9.822	66.9
Mean Water Load	cm/d	8.2	6.8	5.7	4.9	5.8	4.9	3.1
Max Water Load	cm/d	61.5	53.3	42.9	37.8	43.4	38.2	23.6
Inflow Volume	hm3/yr	369.5	351.2	215.5	209.8	184.7	175.1	769.7
Inflow Load	kg/yr	19210.4	12788.4	11206.1	6796.4	9605.2	5756.4	40021.6
Inflow Conc	ppb	52.0	36.4	52.0	32.4	52.0	32.9	52.0
Treated Outflow Volume	hm3/yr	351.2	340.2	209.8	207.6	175.1	173.2	720.9
Treated Outflow Load	kg/yr	12788.4	4765.2	6796.4	2372.8	5756.4	1949.5	9087.5
Treated FWM Outflow Conc	ppb	36.4	14.0	32.4	11.4	32.9	11.3	12.6
Total FWM Outflow Conc	ppb	36.4	14.0	32.4	11.4	32.9	11.3	12.6
Surface Outflow Load Reduc	%	33.4%	62.7%	39.4%	65.1%	40.1%	66.1%	77.3%
Outflow Geometric Mean - Daily	ppb	31.8	9.8	27.7	7.8	28.4	7.8	8.6
Outflow Geo Mean - Composites	ppb	31.6	9.6	27.6	7.6	28.2	7.5	8.4
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	0%	100%	0%	38%

6.6. Implementation Schedule

The Integrated Alternative would be scheduled for completion in 2014, concurrent with the presently scheduled completion of the overall EAA Reservoirs project (Phase 1 and Phase 2). Certain elements of the Integrated Alternative would be completed in advance of that date. The following is a listing of the anticipated dates for completion of individual elements of the Integrated Alternative.

- All physical works for STA-2, Alternative 2, as described in Part 3, would be complete by December 31, 2006.
- All physical works for STA-3/4, Alternative 2, as described in Part 4, would be complete by December 31, 2006.
- All physical works for STA-6, Alternative 4, as described in Part 5, would be complete by December 31, 2006 (includes completion of STA-6, Section 2, as presently structured in the Everglades Construction Project).
- The optimization or enhancement of STA-5 would be conducted in two distinct phases; upon completion, the works would be similar to that described in Part 5 for STA-5, Alternative 4.
    - Conversion of Cell 2B to Submerged Aquatic Vegetation, as well as the addition of gates and automation at the G-343 structures, would be complete by December 31, 2006.
    - Remaining works, including the new pumping stations for the L-2 and Deer Fence/S&M canals, would be complete in 2014.
- Construction of the EAA Reservoirs, Component A, would be complete in 2009, the presently scheduled date for completion of the EAA Reservoirs project, Phase 1.
- Construction of the EAA Reservoirs, Components B and C, would be complete in 2014.

6.7. Total Discharges from Integrated Alternative

A summary of the total average annual discharge volumes and TP loads from the Integrated Alternative for STA-2, STA-3/4, STA-5 and STA-6 combined following full implementation is presented in Table 6.12.

Table 6.12 Average Annual Discharges for Integrated Alternative, 2015-2056

STA Identification	Average Annual Discharge		
	Volume (ac-ft)	TP Load (kg)	TP Conc. (ppb)
STA-2 (refer to Table 6.9)	189,500	3,268.2*	14*
STA-3/4 (refer to Table 6.11)	584,400	10,097.2*	14*
STA-5 (refer to Table 6.6)	124,500	2,155.4*	14*
STA-6 (refer to Table 6.7)	69,600	1,201.3*	14*
Ave. Annual Discharge for Period	**968,000**	**16,722.1***	**14***

*Increased from computed value to reflect lower limit of calibration range.

Table 6.13 summarizes the estimated total discharges from the Integrated Alternative over the 50-year period 2007-2056, given that:

- For the period 2007-2014, total discharges will consist of discharges from:
    - STA-2, Alternative 1 configuration, existing condition inflows.
    - STA-3/4, Alternative 2 configuration, existing condition inflows.
    - STA-5, Alternate 2 configuration, existing condition inflows.
    - STA-6, Alternative 2 configuration, existing condition inflows.
- For the period 2015-2056, discharges would be as identified in Table 6.12.

Table 6.13 Integrated Alternative, Total 50-Year Discharges

Period		Disch. From	Refer. Table	Ave. Annual Discharge		Total Discharge for Period	
From	To			Volume (ac-ft)	TP Load (kg)	Volume (ac-ft)	TP Load (kg)
2007	2014	STA-2	3.11	222,600	4,568.1	1,780,800	36,545
		STA-3/4	4.21	621,200	10,980.1	4,969,600	87,841
		STA-5	5.33	125,500	3,031.8	1,004,000	24,254
		STA-6	5.34	35,100	746.3	280,800	5,970
		Subtotal	-	1,004,400	19,326.3	8,035,200	154,610
2015	2056	All	6.12	968,000	16,722.1*	40,656,000	702,328*
2007	**2056**	**All**	**N/A**	**973,800**	**17,138.8***	**48,691,200**	**856,938***
Flow-weighted mean TP concentration in discharges, ppb							**14***

*Increased from computed value to reflect lower limit of calibration range.

6.8. Capital Cost Estimates

Inasmuch as the Integrated Alternative contemplates substantial modification to the2050wPROJ simulation, it would be desirable to identify the impact of those modifications on the overall cost of the EAA Reservoirs Phase 1 and Phase 2 Projects. Conceptual cost estimates prepared in connection with the conduct of the Restudy are not entirely consistent with the overall configuration presented in the current Project Management Plan for the EAA Reservoirs, Phase 1 project, and in any event are not available in sufficient detail to permit evaluation of the cost impacts of this alternative. It is therefore necessary to limit discussion of the potential impact of the Integrated Alternative on the EAA Reservoirs Phase 1 and Phase 2 Projects to identification of the changed or modified physical works of the assumptions used in the 2050wPROJ simulation. These modifications may or may not be applicable to the EAA Storage Reservoirs Phase 1 Project, which has not yet been defined to any degree of detail.

6.8.1. EAA Reservoirs, Base Configuration

The EAA Reservoirs Phase 1 and Phase 2 Project as simulated in 2050wPROJ for the Basin-specific Feasibility Studies includes a total of four compartments, the operation of three of which were simulated to impact inflow volumes and TP loads to STA-3/4. Two of those three compartments (A1 and A2) were simulated as being situated north of STA-3/4, generally between the North New River (NNR) and Miami canals. The third compartment (Compartment B) was simulated to be east of the North New River Canal adjacent to STA-2. The fourth compartment (Compartment C) was simulated to be between STA-5 and STA-6, immediately west of the Rotenberger Tract.

Compartment A1 was simulated to receive runoff from the NNR and Miami canal basins. Outflows from Compartment A1 were simulated to consist primarily of irrigation supply to the NNR and Miami canal basins. In addition, overflows from Compartment A1 were simulated as being directed to Compartment A2.

Compartment A2 was simulated to receive, in addition to those overflows from A1, regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. Outflows from Compartment A2 were simulated as being directed primarily to STA-3/4, and consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface). In addition to those outflows, overflows from Compartment A2 were simulated as being directed to Compartment B.

Compartment B was simulated to receive, in addition to those overflows from A2, regulatory releases from Lake Okeechobee, also intended for use in satisfying environmental water supply demands. All outflows from Compartment B were simulated as being directed to STA-3/4, and consisting of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

Compartment C was simulated to receive regulatory releases from Lake Okeechobee, intended for use in satisfying environmental water supply demands. All outflows from

Compartment C were simulated to be directed to STA-6, and consist of both surface outflows (discharges when the reservoir stage is above ground surface) and subsurface outflows (discharges when the reservoir stage is at or below ground surface, extending to 18 inches below the ground surface).

A schematic of the peak daily discharges to and from Compartments A1, A2 and B of the EAA Reservoir project, as simulated in 2050wPROJ, is presented in Figure 6.2.

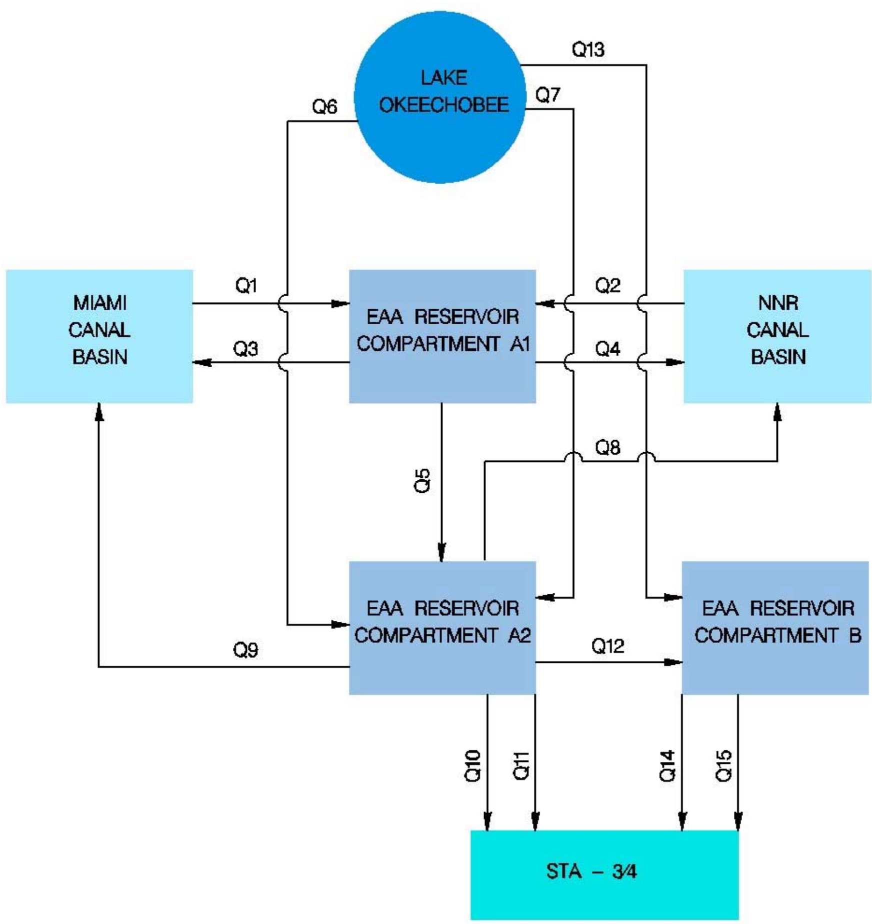

Figure 6.2 EAA Reservoirs Flow Schematic Vicinity STA-3/4

A listing of the maximum daily rates of discharge between the various reservoir compartments and STA-3/4 and STA-6 is presented in Table 6.14.

Table 6.14 Maximum Daily Discharges, EAA Reservoirs, 2050wPROJ Simulation

Flow Ident.	Description	Max. Daily Discharge (cfs)
Q1	Miami Canal Basin Runoff to Comp. A1	2,700
Q2	NNR Canal Basin Runoff to Comp. A1	2,300
Q3	Miami Canal Basin Irrigation from A1	1,157
Q4	NNR Canal Basin Irrigation from A1	1,481
Q5	Overflow, Compartment A1 to A2	1,168
Q6	Lake Regulatory Release to A2, Miami Canal	4,500
Q7	Lake Regulatory Release to A2, NNR Canal	3,000
Q8	NNR Canal Basin Irrigation from A2	1,376
Q9	Miami Canal Basin Irrigation from A2	942
Q10	STA-3/4 Inflow from A2, Surface	3,670
Q11	STA-3/4 Inflow from A2, Subsurface	750
Q12	Overflow, Compartment A2 to B	375
Q13	Lake Regulatory Release to B, NNR Canal	3,000
	Max. Daily Compartment B Inflows	3,375
Q14	STA-3/4 Inflow from B, Surface	3,670
Q15	STA-3/4 Inflow from B, Subsurface	750
	Lake Regulatory Release to C, Miami Canal	1,000
	STA-6 Inflow From C, Surface	1,000
	STA-6 Inflow From C, Subsurface	700

Inspection of the 2050wPROJ simulation future (with CERP) inflow data for STA-3/4 indicates that Pumping Stations G-370 and G-372 are utilized up to their nominal capacity for direct inflows to STA-3/4 (e.g., the capacity of those stations would not be considered as contributing to the above inflow rates to the EAA Reservoirs).

6.8.2. EAA Reservoirs, Integrated Alternative

The alternative EAA Reservoir project as formulated for the Integrated Alternative includes a total of three components, arranged and located generally as indicated in Figure 6.1.

Component A will receive all 2050wPROJ simulated inflows from the NNR and Miami canals, other than those Lake Okeechobee regulatory releases which were simulated as being delivered to Component C. Outflows from Compartment A will consist of irrigation supply to the NNR and Miami canal basins, and discharges to STA-3/4.

Compartment B will receive all 2050wPROJ simulated inflows to STA-2. All outflows from Compartment B will be directed to STA-2.

Compartment C will receive 2050wPROJ simulated regulatory releases from Lake Okeechobee, as well as all runoff from the C-139 Basin. All outflows from Compartment C will be directed to STA-5 and STA-6.

A listing of the maximum daily rates of discharge between the various reservoir compartments and stormwater treatment areas is presented in Table 6.15.

Table 6.15 Maximum Daily Discharges, EAA Reservoirs, Integrated Alternative

Flow Ident.	Description	Max. Daily Discharge (cfs)
Q1	Miami Canal Total Inflow to Component A	6,370
Q2	NNR Canal Total Inflow to Component A	4,470
Q3	Miami Canal Basin Irrigation from Component A	1,157
Q4	NNR Canal Basin Irrigation from Component A	1,481
Q10	STA-3/4 Inflow from Component A, Surface	6,440
	Max. Daily Compartment B Outflows to STA-2	3,343
	Lake Regulatory Release to C, Miami Canal	1,000
	C-139 Basin Inflow to Component C	2,096
	STA-6 Inflow From C, Surface	1,239
	STA-5 Inflow From C, Surface	2,233

For this Integrated Alternative configuration, Pumping Stations G-370 and G-372 are fully available for use as inflow pumping stations to Component A, with the result that the maximum daily inflows to Component A can be met with additional pumping station capacities of 2,700 cfs on the Miami Canal, and 2,300 cfs on the North New River Canal.

In addition, for this Integrated Alternative, there would be no anticipated need for a new inflow pumping station at Component B. The existing inflow pumping stations for STA-2 would fulfill that function (the maximum design stage in Component B was established to permit that function).

6.8.3. Summary of Adjustments to EAA Reservoir Phase 1 and Phase 2 Projects

As contemplated herein, the 2050wPROJ modeled configuration of the EAA Reservoirs Projects would be modified as follows in connection with the Integrated Alternative.

<u>Compartments A1 and A2</u>

Compartments A1 and A2 as modeled in 2050wPROJ have net areas of 20,000 and 21,500 acres respectively. In this Integrated Alternative, Al and A2 would be combined into a single compartment (Component A) occupying a gross area of 31,430 acres and providing a net reservoir area of approximately 30,370 acres. The usable storage depth would be increased from approximately 2.1 meters as modeled in 2050wPROJ to 3.3 meters. The following additional adjustments to 2050wPROJ would be included as well:

- The total length of levee forming the reservoir(s) would be reduced from roughly 53 miles to 42 miles. The height of the levees would be increased due to the greater usable storage depth (from approximately 15 feet above grade to approximately 20 feet above grade).
- Two inflow pumping stations associated with Compartment A1 would be deleted (2,700 cfs pumping station at the Miami Canal and 2,300 cfs pumping station at the North New River Canal, including new bridges on U.S. Highway 27).

- Two irrigation return structures associated with Compartment A1 would be deleted (1,200 cfs structure at the Miami Canal and 1,500 cfs structure at the North New River Canal).
- The overflow structure from Compartment A1 to Compartment A2 (1,200 cfs capacity) would be eliminated.
- The nominal capacity of two irrigation return structures associated with Compartment A2 would be increased. At the Miami Canal, the increase in capacity would be from 1,000 cfs to 1,200 cfs. At the North New River Canal, the increase in capacity would be from 1,400 cfs to 1,500 cfs.
- Inflow pumping stations originally associated with Compartment A2 would be reduced in nominal capacity to reflect the modified operation of Pumping Stations G-370 and G-372 as inflow stations to Component A (all STA-3/4 inflows would first pass through Component A). The newly installed pumping capacity from the Miami Canal would be reduced from 4,500 cfs to 2,700 cfs. The newly installed pumping capacity from the North New River Canal would be reduced from 3,000 cfs to 1,700 cfs.

Compartment B

This compartment (presently modeled in 2050wPROJ as providing a net surface area of 9,500 acres) would be replaced by Component B, providing a net surface area of approximately 8,850 acres on a gross land area of 9,302 acres. The usable storage depth would be reduced slightly from that modeled in 2050wPROJ in order to permit use of existing Pumping Station S-6 as the principal inflow pumping station to the reservoir component. No significant change in levee height would be anticipated. The following additional adjustments to 2050wPROJ would be included as well:

- It would be necessary to extend a new inflow canal, adjacent containment levee, and seepage canal along the north line of STA-2, connecting the existing STA-2 Supply Canal to Component B.
- New seepage return pumping stations would be needed to replace G-337A and G-337B.
- A 3,375 cfs inflow pumping station from the North New River Canal would be deleted.
- A 3,670 cfs capacity outflow control structure (originally intended to direct outflow to STA-3/4) would be relocated to direct inflows to STA-2 at the westerly end of the existing STA-2 Inflow Canal; the nominal capacity of the structure would be reduced to 3,350 cfs.

Compartment C

This compartment (presently modeled in 2050wPROJ as providing a net surface area of 9,000 acres) would be replaced by Component C, providing a net surface area of approximately 8,700 acres on a gross land area of 8,884 acres. The usable storage depth would be increased from approximately 2.1 meters as modeled in 2050wPROJ to 2.8 meters. The following additional adjustments would be included as well:

- The height of the levees would be increased due to the greater usable storage depth (from approximately 15 feet above grade to approximately 18 feet above grade).
- The nominal capacity of the outflow structure controlling discharges to STA-6 would be increased from 1,000 cfs to 1,240 cfs.

In this analysis, costs associated with the introduction of C-139 Basin runoff to the Western reservoir, and for discharges from the reservoir to STA-5, have been gathered with the estimated costs for STA enhancements. It should be noted that the need for the new inflow pumping stations would result strictly from the desire to direct C-139 Basin discharges to the reservoir. They would not otherwise be needed for STA-5.

6.8.4. Capital Cost for Integrated Alternative

Table 6.16 presents a summary opinion of the total capital cost of the Integrated Alternative presented herein. The total opinion of capital cost is comprised of the sum of the following:

- Estimated capital cost for STA-2, Alternative 1.
- Estimated capital cost for STA-3/4, Alternative 2.
- Estimated capital cost for STA-5, Alternative 4.
- Estimated capital cost for STA-6, Alternative 4.

Table 6.16 Opinion of Capital Cost, Integrated Alternative

Component Description	**Reference**	**Estimated Cost**
STA-2, Alternative 1	Table 3.15	$8,500,000
STA-3/4, Alternative 2	Table 4.17	$9,150,000
STA-5, Alternative 4	Table 5.63	$39,200,000
STA-6, Alternative 4 (same as Alternative 3)	Table 5.50	$2,330,000
Total, STA Enhancements		**$59,180,000**

The opinions of probable capital costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

6.9. Incremental Operation and Maintenance Cost Estimates

Inasmuch as the Integrated Alternative contemplates substantial modification to the 2050wPROJ simulation, it would be desirable to identify the impact of those modifications on the overall cost of the EAA Reservoirs Phase 1 and Phase 2 projects. However, no estimate of the anticipated Operations and Maintenance Costs for the EAA Reservoirs Projects is available for such a comparison.

Table 6.17 presents a summary opinion of the average annual incremental operation and maintenance cost of the Integrated Alternative presented herein. The total opinion of capital cost is comprised of the sum of the following:

- Estimated incremental O&M cost for STA-2, Alternative 1.
- Estimated incremental O&M cost for STA-3/4, Alternative 2.
- Estimated incremental O&M cost for STA-5, Alternative 4.
- Estimated incremental O&M cost for STA-6, Alternative 4.

Table 6.17 Opinion of Incremental O&M Cost, Integrated Alternative

Component Description	Reference	Estimated Cost
STA-2, Alternative 2	Table 3.16	$260,000
STA-3/4, Alternative 2	Table 4.18	$310,000
STA-5, Alternative 4	Table 5.64	$905,000
STA-6, Alternative 4 (same as Alternative 3)	Table 5.52	$95,000
Total, STA Enhancements		**$1,570,000**

The opinions of probable operation and maintenance costs presented herein are considered suitable for the development and evaluation of alternatives at the feasibility study level, but should not be taken as firm estimates of the cost for implementation of any given alternative. All estimated costs are stated at current (2002) pricing levels.

6.10. Opinion of Present Cost

The total present cost of capital improvements associated with the STA optimization and enhancement components of the Integrated Alternative is presented in Table 6.18, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 6.18 Opinion of Present Capital Cost, Integrated Alternative, STA Components

Location	Expend.	Estimated Cost ($1,000s, 2002 $) by Year												Total
	Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Expend
STA-2	PED	$550												$550
	P&CM		$275	$275										$550
	Const.		$2,700	$2,700										$5,400
	Cont.		$1,000	$1,000										$2,000
	Lands													$0
STA-3/4	PED	$590												$590
	P&CM		$295	$295										$590
	Const.		$2,930	$2,930										$5,860
	Cont.		$1,055	$1,055										$2,110
	Lands													$0
STA-5	PED	$100									$2,400			$2,500
	P&CM		$50	$50								$1,200	$1,200	$2,500
	Const.		$550	$550								$11,750	$11,750	$24,600
	Cont.		$250	$250								$4,250	$4,250	$9,000
	Lands										$600			$600
STA-6	PED	$150												$150
	P&CM		$75	$75										$150
	Const.		$745	$745										$1,490
	Cont.		$270	$270										$540
	Lands													$0
All	Total	$1,390	$10,195	$10,195	$0	$0	$0	$0	$0	$0	$3,000	$17,200	$17,200	$57,790
Escalated Cost		$1,432	$10,816	$11,140	$0	$0	$0	$0	$0	$0	$4,032	$23,809	$24,523	$74,320
12/31/02 PC		$1,346	$9,558	$9,255	$0	$0	$0	$0	$0	$0	$2,173	$12,064	$11,682	$44,732

The total present cost of incremental operation and maintenance associated with the STA optimization and enhancement components of the Integrated Alternative is presented in Table 6.19, and is computed as of December 31, 2002. It is based on a 50-year project life extending from January 1, 2007 through December 31, 2056 (period of analysis), a discount rate of 6-3/8%, and an average annual cost escalation of 3%.

Table 6.19 Opinion of Present Cost, Incremental O&M, Integrated Alternative, STA Components

Year	Incremental O&M Cost by Location, in $1,000 2002 $					Escalated	12/31/2002
	STA-2	STA-3/4	STA-5	STA-6	Total	Cost	Present Cost
2007	$260	$310	$80	$95	$745	$864	$634
2008	$260	$310	$80	$95	$745	$890	$614
2009	$260	$310	$80	$95	$745	$916	$594
2010	$260	$310	$80	$95	$745	$944	$576
2011	$260	$310	$80	$95	$745	$972	$557
2012	$260	$310	$80	$95	$745	$1,001	$540
2013	$260	$310	$80	$95	$745	$1,031	$523
2014	$260	$310	$80	$95	$745	$1,062	$506
2015	$260	$310	$905	$95	$1,570	$2,306	$1,032
2016	$260	$310	$905	$95	$1,570	$2,375	$1,000
2017	$260	$310	$905	$95	$1,570	$2,446	$968
2018	$260	$310	$905	$95	$1,570	$2,519	$937
2019	$260	$310	$905	$95	$1,570	$2,595	$908
2020	$260	$310	$905	$95	$1,570	$2,673	$879
2021	$260	$310	$905	$95	$1,570	$2,753	$851
2022	$260	$310	$905	$95	$1,570	$2,836	$824
2023	$260	$310	$905	$95	$1,570	$2,921	$798
2024	$260	$310	$905	$95	$1,570	$3,008	$772
2025	$260	$310	$905	$95	$1,570	$3,099	$748
2026	$260	$310	$905	$95	$1,570	$3,191	$724
2027	$260	$310	$905	$95	$1,570	$3,287	$701
2028	$260	$310	$905	$95	$1,570	$3,386	$679
2029	$260	$310	$905	$95	$1,570	$3,487	$657
2030	$260	$310	$905	$95	$1,570	$3,592	$637
2031	$260	$310	$905	$95	$1,570	$3,700	$616
2032	$260	$310	$905	$95	$1,570	$3,811	$597
2033	$260	$310	$905	$95	$1,570	$3,925	$578
2034	$260	$310	$905	$95	$1,570	$4,043	$560
2035	$260	$310	$905	$95	$1,570	$4,164	$542
2036	$260	$310	$905	$95	$1,570	$4,289	$525
2037	$260	$310	$905	$95	$1,570	$4,418	$508
2038	$260	$310	$905	$95	$1,570	$4,550	$492
2039	$260	$310	$905	$95	$1,570	$4,687	$476
2040	$260	$310	$905	$95	$1,570	$4,827	$461
2041	$260	$310	$905	$95	$1,570	$4,972	$446
2042	$260	$310	$905	$95	$1,570	$5,121	$432
2043	$260	$310	$905	$95	$1,570	$5,275	$419
2044	$260	$310	$905	$95	$1,570	$5,433	$405
2045	$260	$310	$905	$95	$1,570	$5,596	$392
2046	$260	$310	$905	$95	$1,570	$5,764	$380
2047	$260	$310	$905	$95	$1,570	$5,937	$368
2048	$260	$310	$905	$95	$1,570	$6,115	$356
2049	$260	$310	$905	$95	$1,570	$6,299	$345
2050	$260	$310	$905	$95	$1,570	$6,488	$334
2051	$260	$310	$905	$95	$1,570	$6,682	$323
2052	$260	$310	$905	$95	$1,570	$6,883	$313
2053	$260	$310	$905	$95	$1,570	$7,089	$303
2054	$260	$310	$905	$95	$1,570	$7,302	$294
2055	$260	$310	$905	$95	$1,570	$7,521	$284
2056	$260	$310	$905	$95	$1,570	$7,747	$275
Total	**$13,000**	**$15,500**	**$38,650**	**$4,750**	**$71,900**	**$196,792**	**$28,684**

Table 6.20 summarizes the estimated total present worth of the Integrated Alternative.

Table 6.20 Summary Opinion of Present Cost, Integrated Alternative

Description	Refer to Table	Present Cost (in $1,000)
Present Worth of Capital Costs, STA Enhancements	6.18	$44,732
Present Worth of Incremental O&M, STA Enhancements	6.19	$28,684
Total, Present Worth of STA Enhancements		$73,416

6.11. Summary of Evaluation Criteria Scoring

Table 6.21 presents a summary of the evaluation criteria scoring for the Integrated Alternative. The information presented therein will subsequently be employed by the District and others in further evaluation of the alternative, and identification of that alternative or alternative(s) to be carried forward to the conceptual design phase.

Table 6.21 Summary Evaluation Criteria Scores, Integrated Alternative

Criteria			Unit	Value	Source of Data
Technical Performance Evaluation:				**ENTER**	**ENTER**
1,2	Level of Phosphorus Reduction				
	1	50-Year TP Load Disc. - Baseline	tonnes	2,075	Table 6.4
		50-Year TP Load Disc. - Alternative Int*	tonnes	857	Table 6.13*
		Phosphorus Load Reduction	%	58.7	Computed
	2a	Long-term flow-weighted mean TP concentration	ppb	14*	Table 6.12
	2b	Long-term geometric mean of 7-day composite TP concentrations	ppb	-	
3	Implementation Schedule		years	4	2006 Specified Completion, from 01/03
4	Operational Flexibility, including adaptive management		-3 (worst) +3 (best)	3	BPJ, based on review of information presented in STSOC (see Part 1)
5	Resiliency to extreme conditions		-4 (worst) +4 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
6	Assessment of full-scale construction and operation		-3 (worst) +3 (best)	1	BPJ, based on review of information presented in STSOC (see Part 1)
7	Management of side streams		-3 (worst) +3 (best)	-1	BPJ, based on review of information presented in STSOC (see Part 1)
Environmental Evaluation:					
1	Level of improvement in non-phosphorus parameters		-19 (worst) +19 (best)	2	Table 1.5
Economic Evaluation:					
1,2	Costs				
	1	50-yr Present Worth Cost	$	$73,416,380	Table 6.20
	2	Total 50-Year TP Removal	kg	1,217,809	Difference Between 50-Year TP Discharges
	2	Cost-effectiveness	$/kg	$60.29	Computed

BPJ = Best Professional Judgment
STSOC = Supplemental Technology Standard of Comparison
TP = Total Phoshphorus
Long-Term TP Concentrations are for fully implemented alternative
Present Worth Cost for 50-Year Life (2007-2056)
- Worth as of 12/31/2002
- 3% Escalation Rate from 12/31/2002 dollars
- Discount Rate of 6-3/8%

* Computed F.W.M. Conc. Less than LSC assigned as 14 ppb.

6.12. Sensitivity Analyses of Phosphorus Reduction Parameters

The effectiveness of phosphorus reduction in the alternatives considered are examined with respect to the change in the following three input parameters presented in the sensitivity analyses:

- Varying BMP Performance
- Different SAV Communities
- All Input Parameters
- Uncertainty Analysis

The third analysis (all input parameters) also employs an uncertainty analysis. The information presented therein will assist the District in further analyses of the alternatives presented in the future evaluation of the parameters.

6.12.1. Variation in BMP Performance

The current level of 50% TP load reduction in basin runoff due to BMPs in the EAA was varied to 25% and 75% TP load reduction to determine the effects the performance level of BMP on the phosphorus reduction parameters. The TP inflows into STA's were recalculated, including those involving the EAA Reservoir Projects. Table 6.28 summarizes, for the Integrated Alternative, the outcome of the phosphorus reduction performance due to varying BMP performance.

As with individual STA results presented in Parts 2 through 5, the results for the Integrated Alternative show that the phosphorus reduction performance is relatively insensitive to BMP performance.

Table 6.22 Variation in BMP Performance

Condition	Location	TP Conc. For BMP Load Reduction					
		25%		50%		75%	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
STA-2		Hills / WPB Canal Basin					
	Inflows	88	--	68	--	46	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-3/4		Miami / NNR Canal Basin					
	Inflows	58	--	52	--	47	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-5		USSC Basin#					
	Inflows	78	--	78	--	65	--
	Outflows	14*	10**	14*	10**	14*	10**
STA-6		USSC Basin#					
	Inflows	78	--	78	--	65	--
	Outflows	14*	10**	14*	10**	14*	10**

#also includes a 25% BMP Reduction of the C-139 Basin in the 75% BMP Case.
*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo. Mean Conc. Less than LSC assigned as 10 ppb.

6.12.2. Variation in SAV Performance

The current vegetative community (SAV_C4) within the four STA's was changed to the vegetative community (NEWS) to determine the effects of different vegetative communities on the phosphorus reduction parameters. In addition, all cells within the four STA's were converted to NEWS to determine the effects of STA's composed entirely of NEWS (ALLNEWS). Table 6.23 summarizes, for each of the four STA's, the outcome of the phosphorus reduction performance due to different SAV communities.

The results show that the phosphorus reduction performance is fairly sensitive to the SAV community used.

Table 6.23 Variation in SAV Performance

Condition	Location	TP Conc. For Different SAV Communities					
		SAV_C4		NEWS		ALLNEWS	
		F.W.	Geo.	F.W.	Geo.	F.W.	Geo.
STA-2							
	Inflows	68	--	68	--	68	--
	Outflows	14*	10**	19	10	18	10**
STA-3/4							
	Inflows	52	--	52	--	52	--
	Outflows	14*	10**	19	13	16	10
STA-5							
	Inflows	78	--	78	--	78	--
	Outflows	14*	10**	20	12	18	10**
STA-6							
	Inflows	78	--	78	--	78	--
	Outflows	14*	10**	20	12	18	10**

*Computed F.W.M. Conc. less than LSC assigned as 14 ppb.
**Computed Geo. Mean Conc. Less than LSC assigned as 10 ppb.

6.12.3. All Input Variables (DMSTA Sensitivity Model)

The sensitivity of the phosphorus reduction performance to all input variables available in the DMSTA model was tested through its built-in Sensitivity Model which also includes an Uncertainty Analysis module. The Sensitivity Model assesses the average percent change in these four output parameters for each input changed:

- Treated Flow-weighted Mean Outflow Concentration
- Total Flow-weighted Mean Outflow Concentration
- Outflow Geometric Mean – Composite
- Total Outflow Load

A Sensitivity Scale Factor of 25% (i.e. 25% change in each input) was used in all runs. Both high and low results were tested; in other words, two runs were conducted for each input variable, one at 75% and the other at 125% of the original value of the input variable under consideration. With approximately 25 different input variables, multiplied by the number of cells in the STA, and the high and low end of results tested, the Sensitivity Analysis included a potential of 100 or more DMSTA runs for each case.

No change in output from any run for each case exceeded 25%. The biggest changes in the four output variables, consistently across each case, were caused by the following input variables:

- Inflow Fraction
- C0 = WC Conc at 0 g/m2 P Storage
- Surface Area
- "K" Settling Rate

The DMSTA Model also includes an Uncertainty Analysis that lists the actual change of any one of the four above-listed output variables based on the "uncertainty" of the input variables. If one of the 23 variables (available in this analysis) under consideration is insensitive, then the range of values will not change significantly.

The DMSTA Uncertainty Analysis uses results from the above Sensitivity Model. The input into the model is the variable labeled "Error CV", which is the Standard Error divided by the Mean. The default input Error CV in the DMSTA model was utilized for the analyses. The outputs are the 10th, 50th, and 90th percentile estimate of the four listed output parameters.

Since the analysis of the Integrated Alternative includes no bypass analysis, the resultant Total Flow-weighted Mean Outflow Concentration is the same as the resultant Treated Flow-weighted Mean Outflow Concentration. Outputs from the four DMSTA cases are shown in Table 6.24:

Table 6.24 Uncertainty Analyses of All Input Variables

Condition	TP Conc. In DMSTA Sensitivity Analyses								
	10th Percentile Est.			50th Percentile Est.			90th Percentile Est.		
	F.W.	Geo.	Load	F.W.	Geo.	Load	F.W.	Geo.	Load
STA-2 Integrated Outflows	14*	10**	3,268*	14*	10**	3,268*	14	10**	3,303
STA-3/4 Integrated Outflows	14*	10**	10,097*	14*	10**	10,097*	15	10	11,157
STA-5 Integrated Outflows	14*	10**	2,155*	14*	10**	2,155*	15	10**	2,367
STA-6 Integrated Outflows	14*	10**	1,201*	14*	10**	1,201*	17	10	1,417

* Increased from computed value to reflect lower limit of calibration range.
**Computed Geo. Mean Conc. less than LSC assigned as 10 ppb.

The results show that in the uncertainty analyses, the geometric mean target of the phosphorus concentration for all STAs in the Integrated Alternative is met.